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ABSTRACT

A survey was undertaken in 1976 to obtain short-term estimates of doctorate production directly from the heads of the science departments involved. These biosciences departments were surveyed in the 235 member institutions of the Higher Education Panel that grant doctorates: anatomy, biochemistry, biology, biometry/biostatistics/biomathematics, biophysics, botany, cell biology, ecology, entomology/parasitology, genetics, human pathology, microbiology, nutrition, pharmacology/toxicology, physiology, zoology, and others. The overall response rate was 93 percent. According to the aggregated responses doctorate production will increase 59 percent over the rest of the decade, with a sharp rise in both private and public institutions. The largest numerical gain is anticipated for public institutions, which currently account for nearly three-fourths of all biosciences doctorates awarded. Almost one-fourth of the doctorates in 1975-76 were awarded by the 20 institutions receiving the highest level of National Institutes of Health research support. Fields that accounted for the greatest numbers of doctorates were biology and biochemistry. Other findings are presented in narrated and tabular form. (MSE)

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Production of Doctorates in the Biosciences, 1975-1980: An Experimental Forecast

Frank J. Atelsek and Irene L. Gomberg

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AMERICAN COUNCIL ON EDUCATION

J. W. Peltason, *President*

The American Council on Education, founded in 1918, is a council of educational organizations and institutions. Its purpose is to advance education and educational methods through comprehensive voluntary and cooperative action on the part of American educational associations, organizations, and institutions.

The Higher Education Panel is a survey research program established by the Council for the purpose of securing policy-related information quickly from representative samples of colleges and universities. *Higher Education Panel Reports* are designed to expedite communication of the Panel's survey findings to policy-makers in government, in the associations, and in educational institutions across the nation.

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Background

Available techniques for projecting biomedical research manpower have not, by and large, yielded satisfactory results for planners concerned with anticipating prospective supply/demand imbalances. Such techniques have typically relied on changes in past enrollment patterns and have only partially and indirectly reflected the immediate circumstantial factors which may impact--often uniquely--on the production of Ph.D.-trained biomedical research manpower.

To explore an alternative forecasting approach which would more adequately take account of such factors, the National Institutes of Health asked the American Council on Education to conduct this survey of its Higher Education Panel. The survey was designed to obtain short-term estimates of doctorate production directly from the heads of the science departments involved. Specifically, respondents were asked, first, to indicate the number of doctorate degrees their department had awarded during the 1975-76 academic year and, second, to estimate the number it expected to award in 1977-78 and in 1979-80.

As a basis for manpower projections, such estimates have both negative and positive features. On the negative side, they are subjective and thus vulnerable to error; on the positive side, they are more likely to incorporate economic and other highly circumstantial factors that affect the progress of graduate students toward the doctorate.

Admittedly, an effort to look ahead two to four years involves a large measure of uncertainty, whatever projection method is employed. While those who will receive the doctorate in 1977-78 or in 1979-80 have probably already begun their course of graduate study, it is virtually impossible to pinpoint exactly when each student will complete all the requirements for the degree. For example, among 1976 doctorate recipients in the biological sciences, a median of 6.9 years total time and of 5.7 years registered time elapsed between receipt of the baccalaureate and receipt of

the doctorate[1]. Undoubtedly, variations around these medians are considerable, adding to the difficulty of estimating precisely future doctorate production at the institutional level. Thus, caution should be observed in interpreting the estimates contained here.

Methods Summary

The data for this report were collected as part of a continuing research program of the Higher Education Panel, which was established at the American Council on Education in 1971 for the purpose of conducting small-scale surveys on topics of current policy interest to the higher education community and to government agencies. The Panel is now based on a network of representatives at 760 colleges and universities broadly representative of the nation's more than 3,000 institutions of higher education[2].

The survey questionnaire (Appendix A) was mailed on September 1, 1976, to the 235 member institutions that grant the doctorate degree. The inquiry was specifically directed to heads of the following bioscience departments:

Anatomy	Entomology/parasitology
Biochemistry	Genetics
Biology	Human pathology
Biometry/biostatistics/ biomathematics	Microbiology
	Nutrition
Biophysics	Pharmacology/toxicology
Botany	Physiology
Cell Biology	Zoology
Ecology	Other biosciences

To assure complete coverage, the Panel coordinator at each institution was asked to identify all bioscience departments within the institution and to indicate this

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[1]National Academy of Sciences, National Research Council, Summary Report 1976: Doctorate Recipients from United States Universities, 1977.

[2]Because of the changing composition of the higher education community, a new Panel was drawn in 1976 to better represent the more than 3,000 colleges and universities in the nation. For a full discussion of the sampling procedures used, see J. A. Creager, Development of a Revised Higher Education Panel: A Study of the Taxonomy and Sampling of the Institutional Domain of Higher Education, Final Report (NSF Grant #SRS75-14621) 1976.

information on a return postcard which was mailed with the survey instrument.

Completed questionnaires were received from all departments at 174 institutions, with partial but usable data provided by an additional 14 institutions, for an overall response rate of 93 percent[3]. The data were subsequently weighted by a two-stage ratio estimation procedure (Appendix B). Thus, the weighted results given in this report represent independently computed population estimates, not exact counts: Figures for 1975-76 are actual numbers of degrees conferred, weighted to national estimates; figures for 1977-78 and 1979-80 represent the personal judgments of department heads as to the probable numbers of degrees to be conferred two and four years from the date of the survey. These estimates were also weighted to provide national totals.

Findings

According to the aggregated responses of department heads, doctorate production in the biosciences will increase 59 percent over the rest of the decade, from a level of approximately 3,400 in 1975-76, to 5,000 in 1977-78 and 5,400 in 1979-80 (Table 1). This sharp rise in doctorate production is anticipated at both public and private institutions, with the largest numerical gain indicated for public institutions, which currently account for nearly three-fourths of all bioscience doctorates awarded (Tables 2 and 3).

Almost one-fourth of the bioscience doctorates in 1975-76 were awarded by the "Top 20" institutions--those receiving the highest level of NIH research support (Table 4); the "Bottom 20" awarded less than 5 percent of all 1975-76 bioscience doctorates (Table 5).

Fields which accounted for the greatest number of 1975-76 doctorates were biology and biochemistry (each of which awarded about 15 percent of the total) and microbiology (accounting for 11 percent). It is noteworthy that larger proportions

[3] In the course of the survey it was learned that 33 Panel institutions did not award doctorates in the biosciences. Thus, the survey base within the Panel was reduced to 202.

of doctorates were conferred at public than at private institutions in zoology, botany, and entomology/parasitology, while private institutions awarded proportionately more doctorates in biology and pharmacology/ toxicology (Table 6).

Before examining specific field-by field variations in future doctoral output, it is appropriate to inquire into the reliability of these departmental projections. No assumptions were provided department heads completing the questionnaires; estimates are derived in large measure from respondents' subjective judgments as to the rate at which graduate students would complete work for the doctorate. Some department heads may have based these judgments on recent enrollment trends; others, on the number of years their students had already spent as doctoral candidates; still others, on the students' progress toward the degree in terms of coursework and examinations required. Given the wide variation in the number of years required to complete work for the doctorate, the respondents would have found it difficult to develop a systematic method of estimation. In the biosciences, combination programs (M.D.-Ph.D. or M.A.-Ph.D.) make such estimates even more tenuous.

To ascertain the basis of these estimates, a small group of respondents who had anticipated sharp increases in doctorate production between 1975-76 and 1977-78 were contacted by telephone after the initial survey. Of these, over 70 percent provided specific reasons for assuming that their departments would graduate larger numbers of doctoral students: newly approved doctoral programs, increased sponsorship and funds, additional faculty, newly expanded departments.

Despite the results of this telephone check, it is possible that the unexpectedly high projections indicated for the biosciences may, in part, reflect a reporting artifact. Most bioscience departments award only a few doctorates in a given year. In 1975-76, for example, 74 percent of the responding departments awarded fewer than four doctorates in their fields. Considering that nearly 1,200 separate field responses were made to the HEP survey, an overestimate of one doctoral degree by a number of departments, when cumulated, would introduce a substantial source of error.

Unfortunately, the extent of such distortion cannot be determined because of the subjective nature of the departmental estimates.

Recent projections of Ph.D. output developed by the National Institutes of Health afford a useful framework for testing the fit of the estimates obtained from the present HEP survey (see chart). The NIH projections are based on known first-year, full-time graduate enrollment levels and the distribution of Ph.D.'s by time lapse since graduate entry.

A distribution of bioscience doctorates (since FY 1961), constructed by year of graduate entry and by time lapse to receipt of the doctorate, indicates that the proportion of graduate students receiving the Ph.D. varies considerably from year to year of graduate entry. In the NIH projection method, an appropriate distribution of the proportions of entering graduate classes who receive the doctorate after various time lapses is multiplied by the appropriate first-year graduate enrollment figures and then aggregated to yield alternative distributions[4]:

> Alternative A is based upon a 15-year average of the proportions that all doctorate-recipients represent of their respective entering classes (the upper boundary of the projection).
>
> Alternative B is based upon the percentages that 1976 doctorate-recipients represent of their entering classes.
>
> Alternative C is derived from a straight line projection of the year-to-year trends in the time lapse distribution and reflects the diminishing flow of students in recent years from graduate entry to Ph.D. (the lower boundary of the projection).

As shown, the HEP survey results fall slightly below the high projections and substantially exceed the growth rate of recent years. It is likely, then, that the projections reported here are high; however, the upward trend reflected in these projections is consonant with the fairly substantial growth in graduate enrollment in the life sciences, as reported over the past several years by the Office of

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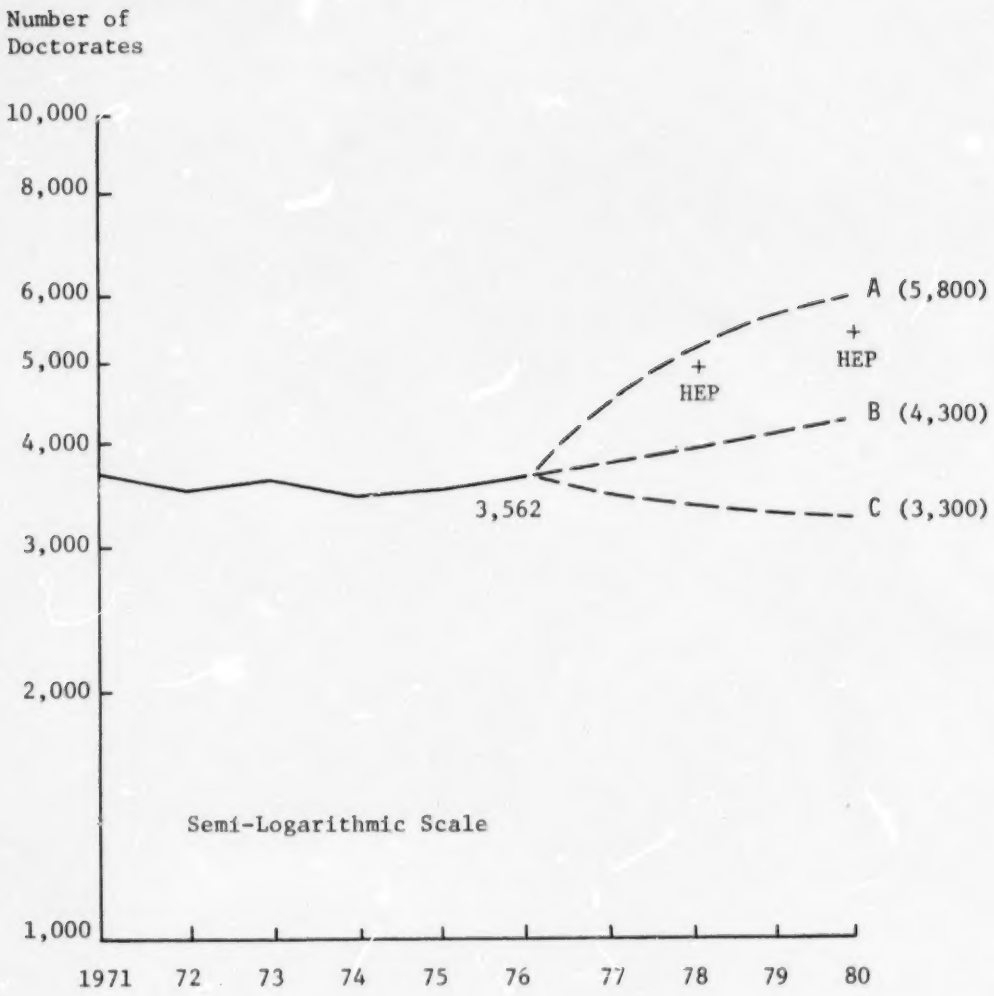
[4] A detailed description of this method is contained in Resources Analysis Memo No. 20, "Projections of Ph.D. Output to 1979-80 in Biosciences: A Methodology," prepared by George Bowden, National Institutes of Health (report scheduled for release in December 1977).

Doctorate Production in the Biosciences
1971-1976 (Actual) and Alternative Projections, 1977 to 1980



Source: National Institutes of Health

Education, the National Science Foundation, and the National Institutes of Health.

Taking the statistics at their face value, it is appropriate to ask about the underlying causes of such an anticipated upward surge in bioscience doctorates. It seems reasonable to assume that economic factors (e.g., depressed job markets) may have induced some graduate students to continue their studies toward the Ph.D.; that national efforts in the late sixties and early seventies to expand research training have borne fruit; that the influx of large numbers of part-time students into the system has affected doctoral output. Moreover, in recent years, only about one of every three applicants to medical school has been accepted into an M.D. program, and it seems likely that the resulting overflow is being absorbed into a variety of graduate programs in the biological sciences. Whatever the specific causes, graduate enrollment in the biosciences has increased substantially over the last several years (contrary to the common expectation that it would drop because of demographic factors), and this increase is likely to result in higher bioscience doctorate production in the years immediately ahead.

Although HEP survey estimates by specific field are subject to the same reservations and qualifications described above, it is believed that the data are adequate to portray gross relationships in assessing field-by-field variations.

Department heads from virtually all fields anticipated substantial increases in doctorate production between 1975-76 and 1979-80. By the end of the decade, Ph.D. output is expected to double in the fields of nutrition, biometry, anatomy, ecology and pharmacology/toxicology; much lower growth rates (between 27 and 40 percent) are expected in the fields of zoology, entomology, botany, biology, and biophysics (Table 1).

The fields expecting unusually large increases differed according to control of the institution (Tables 2 and 3). Thus, at public institutions, the greatest gains were expected in nutrition, anatomy, biometry, and pharmacology; at private institutions, the fields of [illegible]gy, botany, cell biology, and genetics were expected to experience the largest growth in doctorate production. It is significant that

public institutions account for a vast majority of Ph.D.'s awarded in the biosciences--almost 75 percent; this proportion is expected to remain stable through the four-year projection period.

The Top 20 showed a modest gain of 30 percent in overall bioscience doctorate production between 1975-76 and 1979-80, compared with a hefty 79 percent increase for the Bottom 20. In all fields except biometry and cell biology, anticipated increases in the Top 20 were below the national average. These institutions, which accounted for about 24 percent of all bioscience doctorates awarded in 1975-76, will produce only 19 percent of the doctorates in 1979-80.

If the estimates of the departmental heads prove reliable, then the relative proportion of doctorates contributed by each field will remain fairly stable (Tables 6 and 7). Similarly, with few exceptions, only minor shifts will occur in the relative proportion of degrees granted in a given field of study by public and by private institutions or by the Top and by the Bottom 20 institutions.

Conclusion

This report summarizes the collective expectations of department heads regarding the probable number of bioscience doctorates that will be awarded in 1977-78 and 1979-80. Such pragmatically derived estimates provide an additional dimension to existing manpower projections by incorporating the most current circumstantial factors that bear upon doctorate production--factors often inadequately considered in mathematically constructed models. While the limitations of this method are apparent, particularly with respect to assessing error resulting from an essentially subjective reporting process, it is believed that the data reported here reflect genuine tendencies and trends. Thus, while the magnitude and phasing of doctoral production in the biosciences are subject to some reservations, the probability that doctoral output will increase significantly during the remainder of the decade is high. This conclusion is also indicated (or implied) in analyses recently prepared by the National Science Foundation, the Bureau of Labor Statistics, the National Academy of Sciences, and the

National Institutes of Health. Follow-up studies based on NAS-NRC surveys of actual doctorates conferred should permit a better assessment of the validity of the results.

Table 1
Production of Doctorates in the Biosciences, 1975-1980
All Institutions (N = 199)

Field of Study	Number of Doctorates Conferred			Anticipated Change from 1975-76 to:			
	Actual	Estimated		1977-78		1979-80	
	1975-76	1977-78	1979-80	Number	Percent	Number	Percent
Anatomy	110	203	240	93	84.5	130	118.2
Biochemistry	488	674	716	186	38.1	228	46.7
Biology	509	703	706	194	38.1	197	38.7
Biometry/Biostatistics/Biomathematics	62	113	138	51	82.3	76	122.6
Biophysics	97	153	129	61	66.3	37	40.2
Botany	212	243	296	31	14.6	84	39.6
Cell Biology	65	108	104	43	66.2	39	60.0
Ecology	64	108	127	44	68.8	63	98.4
Entomology, Parasitology	152	225	200	73	48.0	48	31.6
Genetics	135	193	218	58	43.0	83	61.5
Human Pathology	81	113	137	32	39.5	56	69.1
Microbiology	386	598	648	212	54.9	262	67.9
Nutrition	48	92	110	44	91.7	62	129.2
Pharmacology/Toxicology	234	398	483	164	70.1	249	106.4
Physiology	233	397	435	164	70.4	202	86.7
Zoology	289	384	368	95	32.9	79	27.3
Other Biosciences	264	337	374	73	27.7	110	41.7
Total	3,424	5,042	5,429	1,618	47.3	2,005	58.6

Table 2
Production of Doctorates in the Biosciences, 1975-1980
Public Institutions (N = 131)

Field of Study	Number of Doctorates Conferred			Anticipated Change from 1975-76 to:			
	Actual	Estimated		1977-78		1979-80	
	1975-76	1977-78	1979-80	Number	Percent	Number	Percent
Anatomy	61	123	144	62	101.6	83	136.1
Biochemistry	359	485	537	126	35.1	178	49.6
Biology	256	383	409	127	49.6	153	59.8
Biometry/Biostatistics/Biomathematics	62	113	138	51	82.3	76	122.6
Biophysics	56	85	78	29	51.8	22	39.3
Botany	203	227	275	24	11.8	72	35.5
Cell Biology	42	47	55	5	11.9	13	31.0
Ecology	54	84	98	30	55.6	44	81.5
Entomology, Parasitology	145	211	189	66	45.5	44	30.3
Genetics	113	159	172	46	40.7	59	52.2
Human Pathology	51	73	83	22	43.1	32	62.7
Microbiology	288	421	479	133	46.2	191	66.3
Nutrition	33	70	82	37	112.1	49	148.5
Pharmacology/Toxicology	146	255	314	109	74.7	168	115.1
Physiology	168	289	326	121	72.0	158	94.0
Zoology	269	360	334	91	33.8	65	24.2
Other Biosciences	196	257	294	61	31.1	98	50.0
Total	2,502	3,642	4,007	1,140	45.6	1,505	60.2

Table 3
Production of Doctorates in the Biosciences, 1975-1980
Private Institutions (N = 68)

Field of Study	Number of Doctorates Conferred			Anticipated Change from 1975-76 to:			
	Actual	Estimated		1977-78		1979-80	
	1975-76	1977-78	1979-80	Number	Percent	Number	Percent
Anatomy	49	80	96	31	63.3	47	95.9
Biochemistry	129	189	179	60	46.5	50	38.8
Biology	253	320	297	67	26.5	44	17.4
Biometry/Biostatistics/Biomathematics	0	0	0	0	0	0	0
Biophysics	36	68	51	32	88.9	15	41.7
Botany	9	16	21	7	77.8	12	133.3
Cell Biology	23	61	49	38	165.2	26	113.0
Ecology	10	24	29	14	140.0	19	190.0
Entomology, Parasitology	7	14	11	7	100.0	4	57.1
Genetics	22	34	46	12	54.5	24	109.1
Human Pathology	30	40	54	10	33.3	24	80.0
Microbiology	98	177	169	79	80.6	71	72.4
Nutrition	15	22	28	7	46.7	13	86.7
Pharmacology/Toxicology	88	143	169	55	62.5	81	92.0
Physiology	65	108	109	43	66.2	44	67.7
Zoology	20	24	34	4	20.0	14	70.0
Other Biosciences	68	80	80	12	17.6	12	17.6
Total	922	1,400	1,422	478	51.8	500	54.2

Table 4
Production of Doctorates in the Biosciences, 1975-1980
"Top Twenty" Institutions

Field of Study	Number of Doctorates Conferred			Anticipated Change from 1975-76 to:			
	Actual	Estimated		1977-78		1979-80	
	1975-76	1977-78	1979-80	Number	Percent	Number	Percent
Anatomy	32	46	60	14	43.8	28	87.5
Biochemistry	146	163	162	17	11.6	16	11.0
Biology	174	209	197	35	20.1	23	13.2
Biometry/Biostatistics/Biomathematics	11	32	31	21	190.9	20	181.8
Biophysics	29	34	36	5	17.2	7	24.1
Botany	25	28	27	3	12.0	2	8.0
Cell Biology	11	32	29	21	190.9	18	163.6
Ecology	0	0	0	0	0	0	0
Entomology, Parasitology	9	9	9	0	0	0	0
Genetics	46	48	62	2	4.3	16	34.8
Human Pathology	25	24	38	-1	-4.0	13	52.0
Microbiology	91	111	106	20	22.0	15	16.5
Nutrition	12	13	15	1	8.3	3	25.0
Pharmacology/Toxicology	50	67	85	17	34.0	35	70.0
Physiology	47	79	76	32	68.1	29	61.7
Zoology	37	38	37	1	2.7	0	0
Other Biosciences	65	75	80	10	15.4	15	23.1
Total	810	1,008	1,050	198	24.4	240	29.6

Table 5
Production of Doctorates in the Biosciences, 1975-1980
"Bottom Twenty" Institutions

Field of Study	Number of Doctorates Conferred			Anticipated Change from 1975-76 to:			
	Actual	Estimated		1977-78		1979-80	
	1975-76	1977-78	1979-80	Number	Percent	Number	Percent
Anatomy	0	0	0	0	0	0	0
Biochemistry	20	26	41	6	30.0	21	105.0
Biology	34	53	55	19	55.9	21	61.8
Biometry/Biostatistics/Biomathematics	0	0	0	0	0	0	0
Biophysics	0	0	0	0	0	0	0
Botany	27	20	44	-7	-25.9	17	63.0
Cell Biology	0	0	0	0	0	0	0
Ecology	0	0	0	0	0	0	0
Entomology, Parasitology	12	23	30	11	91.7	18	150.0
Genetics	2	7	11	5	250.0	9	450.0
Human Pathology	0	0	0	0	0	0	0
Microbiology	6	11	15	5	83.3	9	150.0
Nutrition	0	0	0	0	0	0	0
Pharmacology/Toxicology	0	0	1	0	0	1	0
Physiology	1	6	7	5	500.0	6	600.0
Zoology	29	55	38	26	89.7	9	31.0
Other Biosciences	23	19	34	-4	-17.4	11	47.8
Total	154	220	276	66	42.9	122	79.2

Table 6
Percentage Distribution of Doctorates in the Biosciences, 1975-1980, by Control

Field of Study	All Institutions			Public Institutions			Private Institutions		
	Actual	Estimated		Actual	Estimated		Actual	Estimated	
	1975-76	1977-78	1979-80	1975-76	1977-78	1979-80	1975-76	1977-78	1979-80
Anatomy	3.2	4.0	4.4	2.4	3.4	3.6	5.3	5.7	6.8
Biochemistry	14.3	13.4	13.2	14.3	13.3	13.4	14.0	13.5	12.6
Biology	14.9	13.9	13.0	10.2	10.5	10.2	27.4	22.9	20.9
Biometry/Biostatistics/ Biomathematics	1.8	2.2	2.5	2.5	3.1	3.4	0	0	0
Biophysics	2.7	3.0	2.4	2.2	2.3	1.9	3.9	4.9	3.6
Botany	6.2	4.8	5.5	8.1	6.2	6.9	1.0	1.1	1.5
Cell Biology	1.9	2.1	1.9	1.7	1.3	1.4	2.5	4.4	3.4
Ecology	1.9	2.1	2.3	2.2	2.3	2.4	1.1	1.7	2.0
Entomology, Parasitology	4.4	4.5	3.7	5.8	5.8	4.7	.8	1.0	.8
Genetics	3.9	3.8	4.0	4.5	4.4	4.3	2.4	2.4	3.2
Human Pathology	2.4	2.2	2.5	2.0	2.0	2.1	3.3	2.9	3.8
Microbiology	11.3	11.9	11.9	11.5	11.6	12.0	10.6	12.6	11.9
Nutrition	1.4	1.8	2.0	1.3	1.9	2.0	1.6	1.6	2.0
Pharmacology/Toxicology	6.8	7.9	8.9	5.8	7.0	7.8	9.5	10.2	11.9
Physiology	6.8	7.9	8.0	6.7	7.9	8.1	7.0	7.7	7.7
Zoology	8.4	7.6	6.8	10.8	9.9	8.3	2.2	1.7	2.4
Other Biosciences	7.7	6.7	6.9	7.8	7.1	7.3	7.4	5.7	5.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 7
Percent Distribution of Doctorates in the Biosciences, 1975-1980, by Level of NIH Support

Field of Study	Top 20 Institutions			Bottom 20 Institutions		
	Actual	Estimated		Actual	Estimated	
	1975-76	1977-78	1979-80	1975-76	1977-78	1979-80
Anatomy	4.0	4.6	5.7	0	0	0
Biochemistry	18.0	16.2	15.4	13.0	11.8	14.9
Biology	21.5	20.7	18.8	22.1	24.1	19.9
Biometry/Biostatistics/Biomathematics	1.4	3.2	3.0	0	0	0
Biophysics	3.6	3.4	3.4	0	0	0
Botany	3.1	2.8	2.6	17.5	9.1	15.9
Cell Biology	1.4	3.2	2.8	0	0	0
Ecology	0	0	0	0	0	0
Entomology, Parasitology	1.1	.9	.9	7.8	10.5	10.9
Genetics	5.7	4.8	5.9	1.3	3.2	4.0
Human Pathology	3.1	2.4	3.6	0	0	0
Microbiology	11.2	11.0	10.1	3.9	5.0	5.4
Nutrition	1.5	1.3	1.4	0	0	0
Pharmacology/Toxicology	6.2	6.6	8.1	0	0	.4
Physiology	5.8	7.8	7.2	.6	2.7	2.5
Zoology	4.6	3.8	3.5	18.8	25.0	13.8
Other Biosciences	8.0	7.4	7.6	14.9	8.6	12.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Appendix A: Survey Instrument

AMERICAN COUNCIL ON EDUCATION
ONE DUPONT CIRCLE
WASHINGTON, D. C. 20036

HIGHER EDUCATION PANEL

September 1, 1976

Dear Higher Education Panel Representative:

Enclosed is the thirty-fourth survey of the Higher Education Panel. This survey, requested by the National Institutes of Health, covers the production of doctorates in the biosciences, 1975-1980.

The purpose of the survey is to provide national estimates of doctorates awarded in fields which form the basis of biomedical research and to approximate the supply of doctorates in such fields during the remainder of the decade. Output measures of this nature are of value in assessing the need for and the impact of specific federal programs; such data also serve policy-makers in higher education and contribute to more informed career choices by students.

We are requesting that the actual counts as well as the estimates of future Ph.D. production be obtained from department heads and/or other heads of appropriate campus units where advanced degrees in the biosciences are conferred. The estimates for future doctorate production should be carefully considered and based, insofar as possible, on the number of graduate students actually enrolled in bioscience fields. Please also obtain data from medical schools and other academic components of your institution which may be geographically separate from the main campus *but are still considered part of your institution.*

Please take the time now to complete and return the enclosed postcard to us and distribute the survey forms to the appropriate departments.

You will note on the enclosed instruction sheet, and throughout the survey materials, that the doctorate classification includes degrees such as the Ph.D. and Sc.D. but excludes professional degrees such as the M.D. and D.V.M. Also note that the fields of agriculture and forestry are excluded from this survey.

As usual, the data you provide will be reported in summary fashion only and will not be identifiable with your institution. A copy of the printed report will be sent to you as soon as it becomes available.

We would appreciate receiving the completed questionnaires by September 24, 1976. A self-addressed, stamped envelope has been enclosed for your convenience.

Thank you for your cooperation.

Frank Atelsek

Frank Atelsek

Director

FA:ec
Enclosures

American Council on Education
Higher Education Panel
One Dupont Circle
Washington, D.C. 20036

Higher Education Panel Survey No. 34

Production of Doctorates in the Biosciences
1975-1980
General Instructions

Enclosed are the following:

A. Postcard
B. Questionnaire and attached introductory letter from NIH (12 copies)
C. Return envelope

On the *postcard*, please indicate the number of departments at your institution that award the doctorate in each of the listed fields.

Please return the postcard to the Higher Education Panel as soon as possible.

Please distribute a copy of the *questionnaire* to each department which confers the doctorate in each of the following bioscience fields:

Anatomy
Biochemistry
Biology
Biometry/Biostatistics/Biomathematics
Biophysics
Botany
Cell Biology
Ecology
Entomology/Parasitology
Genetics
Human Pathology (Plant and Animal Pathology should be included with "Other Biosciences")
Microbiology
Nutrition
Pharmacology/Toxicology
Physiology
Zoology
Other Biosciences (excluding Agriculture and Forestry)

(Doctorate includes degrees such as the Ph.D. and Sc. D., but excludes professional degrees such as the M.D. and D.V.M.)

A separate survey form should be used for each field. Data from any number of departments that award the doctorate in the same field - e.g., all in biochemistry -- may be reported on one survey form.

Please wait until the due date of September 24th to return all completed questionnaires in the enclosed preaddressed stamped envelope. ACE will aggregate the data for each field and institution.

Questionnaires you receive after that date should be forwarded immediately to HEP. If you have any questions, please telephone the Panel collect at 202-833-4757.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
NATIONAL INSTITUTES OF HEALTH
BETHESDA, MARYLAND 20014

Dear Colleague:

As part of its continuing assessment of the Nation's resources for health research, the National Institutes of Health is seeking to develop valid estimates of the future supply of Ph.D.s in the life sciences and to anticipate, to the extent possible, prospective supply/demand imbalances.

Heretofore, available techniques for projecting biomedical research manpower by field have been only partly successful; the need exists for more reliable baseline data on expected Ph.D. production in the biosciences. To meet this need we have asked the American Council on Education to conduct this survey through its Higher Education Panel.

We hope through this survey to derive short-term estimates of doctoral output directly from the heads of the science departments involved. The data so obtained should permit us to improve our projections of doctorates in the basic medical sciences and other bioscience fields of interest.

We would greatly appreciate your cooperation in completing the attached questionnaire at your earliest convenience. As is the case with all Higher Education Panel surveys, the data will be reported in summary fashion only and will not be identifiable with any institution.

Thank you for your cooperation.

Sincerely yours,

William E. Rhode

William E. Rhode, Ph.D.
Acting Director
Division of Resources Analysis
Office of Program Planning
and Evaluation

Attachment

Please use a separate form for each field, and make extra copies of this form as needed. ACE will aggregate the data for each field and institution.

List of Fields Surveyed

Anatomy

Biochemistry

Biology

Biometry/Biostatistics/Biomathematics

Biophysics

Botany

Cell Biology

Ecology

Entomology/Parasitology

Genetics

Human Pathology (Plant or Animal Pathology should be included with "Other Biosciences")

Microbiology

Nutrition

Pharmacology/Toxicology

Physiology

Zoology

Other Biosciences (excludes Agriculture and Forestry)

OMB# 99-R0265
exp.6/78

American Council on Education
Higher Education Panel Survey No. 34

Production of Doctorates* in the Biosciences
1975-1980

Field _____

Actual number of doctorates conferred July 1975-June 1976 _____

Estimated number of doctorates to be conferred July 1977-June 1978 _____

Estimated number of doctorates to be conferred July 1979-June 1980 _____

(Note: No estimate is requested for 1976-77 or 1978-79)

*Doctorate includes Ph.D. and Sc.D. degrees but excludes professional degrees such as M.D. and D.V.M.

PLEASE RETURN THIS SURVEY TO YOUR HEP REPRESENTATIVE BY SEPTEMBER 24TH WHO WILL FORWARD IT TO:

American Council on Education
Higher Education Panel
One Dupont Circle, N.W.
Washington, D.C. 20036

PLEASE RETAIN A COPY OF THIS SURVEY FOR YOUR RECORDS

NAME: _____

DEPARTMENT: _____

PHONE: _____

IF YOU HAVE ANY QUESTIONS, PLEASE CALL COLLECT 202-833-4757.

Appendix B: Methodology

At the conclusion of the survey, responses had been received from 188 of the 202 institutional members of the Higher Education Panel qualified to participate in this survey. Of these 188 respondents, however, 21 institutions neither awarded any bioscience doctorates in 1975-76 nor expected to award any during the years under consideration. Thus the number of respondents was reduced to 167.

In many instances, data for one field came from several departments within an institution. Therefore, to facilitate both keypunching and programming, all responses from an institution were aggregated by field. The total population eligible for the survey was then defined to include all colleges and universities which had awarded the doctorate in a bioscience field in 1974-75, according to NCES's Higher Education General Information Survey (HEGIS) on earned degrees conferred. These institutions numbered 199.

The population was stratified into six cells: by control (public, private) and by level of NIH support for projects and resources in FY 1973 (Top 20, Bottom 20, all other), as shown in Table B-1.

Table B-1
Stratification Design for Weighting

Strata	Population	Respondents
Public	131	110
Top 20	7	5
Bottom 20	17	14
All other	107	91
Private	68	57
Top 20	13	13
Bottom 20	3	0
All other	52	44
Total	199	167

Weighting

Weighting was accomplished in two stages:

First Stage. Within each of the six strata and for each field,

A. The sum of doctorate degrees conferred in 1975 was computed for all institutions in the population.

B. The sum of doctorate degrees conferred in 1975 was computed for all institutions responding to the survey by multiplying their doctoral counts by the appropriate net Panel weight (basic institutional weight; i.e., the ratio of the number of institutions in the Panel to the number of institutions in the population separately for each cell).

The total from the first step was divided by the total from the second step, yielding the first-stage weight.

$$f_{i(k)} = \frac{\sum_{j=1}^{N_i} D_{ij(k)-75}}{\sum_{j=1}^{n_i} W_{hij}\, d_{hij(k)-75}}$$

Where

N_i = total number of population institution in stratum i

n_i = total number of responding institutions in stratum i

i = 1,2,...6 strata

h = 1,2,...18 original strata

k = 1,2,...17 bioscience fields

$D_{ij(k)-75}$ = doctorate degrees conferred in field k in 1975 by population institution j in stratum i (from HEGIS)

W_{hij} = net Panel weight for institution j of strata i and h

$d_{hij(k)-75}$ = doctorate degrees conferred in field k in 1975 by responding institution j of stratum i (from HEGIS)

$f_{i(k)}$ = first-stage weight for field k of stratum i

Second Stage. The final weight for field k of stratum i was obtained by multiplying its appropriate first-stage weight by its net Panel weight:

$$W^*_{hij(k)} = f_{i(k)} W_{hij}$$

Where $W^*_{hij(k)}$ = final weight for field k of stratum i, corresponding to institution j of stratum h

The data were then weighted by multiplying the doctorate counts and estimates at responding institutions by their associated final weights.

Comparison of Respondents and Nonrespondents

Of the 235 doctorate-granting institutions in the Higher Education Panel, 188 provided usable data before the deadline for returning questionnaires. Of these respondents, 21 reported conferring no doctoral awards in the biosciences, thus reducing to 167 the number of Panel responses useful for weighting to national estimates. Table B-2 compares these 167 respondents with the remainder of the total universe of 199 doctorate-granting institutions that awarded at least one doctoral degree in a bioscience field in 1974-75.

Since the Panel is a disproportionate stratified sample, respondents differ from nonrespondents in several important respects, notably size. For example, proportionately twice as many nonrespondents as respondents enrolled fewer than 1,000 graduate students (59 percent vs. 30 percent). Of course, the stratification design for weighting the results of the present survey to national estimates adjusts for these inherent biases.

Above-average response rates were recorded for institutions enrolling more than 5,000 graduate students (94 percent) and for institutions in the West (92 percent). Lower-than-average response rates occurred among colleges enrolling fewer than 1,500 students (full-time equivalent) (62 percent) and among colleges enrolling fewer than 1,000 graduate students (72 percent).

Table B-2

Comparison of Survey Respondents with Population Nonrespondents
(In Percentages)

Characteristic	Survey Respondents (N=167)	Population Nonrespondents (N=32)	Response Rate
Total	100.0	100.0	83.9
Control			
Public	65.9	65.6	84.0
Private	34.1	34.4	83.8
Graduate Enrollment (FTE)			
<1,000	30.0	59.4	72.5*
1,000-3,000	44.9	25.0	90.4
3,001-5,000	15.0	12.5	86.2
>5,000	10.2	3.1	94.4*
Total Enrollment (FTE)			
<1,500	9.6	31.2	61.5*
1,501-5,000	12.6	18.8	77.8
5,001-10,000	27.5	18.8	88.5
>10,000	50.3	31.3	89.4
Census Region			
East	26.3	34.4	80.0
Midwest	21.6	31.3	78.3
South	31.1	25.0	86.7
West	21.0	9.4	92.1

*Exceeds or falls short of the overall response rate by more than 10 percent.

Other Reports of the Higher Education Panel
American Council on Education

Blandford, B. and Dutton, D. **Survey of First-Year Graduate and Postdoctoral Enrollment in Science and Engineering.** Higher Education Panel Report, No. 1, August, 1971.

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Astin, A., Blandford, B., and Mahn, T. **Freshman Class Vacancies in Fall 1971 and Recent Trends in Enrollment of Minority Freshmen.** Higher Education Panel Report, No. 3, February, 1972.

Changes in Graduate Programs in Science and Engineering 1970-72 and 1972-74. Science Resources Studies Highlights. Washington: National Science Foundation, July, 1972.

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Furniss, W. T. **Faculty Tenure and Contract Systems: Current Practice.** ACE Special Report, July, 1972.

Bayer, A. E. and Astin, A. W. **War Protest on U. S. Campuses During April 1972.** Higher Education Panel Report, No. 9, May, 1972.

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Blandford, B. A. **Student Participation on Institutional Governing Boards.** Higher Education Panel Report, No. 11, October, 1972.

Dutton, J. E. and Blandford, B. A. **Enrollment of Junior-Year Students (1971 and 1972).** Higher Education Panel Report, No. 12, April, 1973.

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Dutton, J. E. and Jenkins, M. D. **The Urban Involvement of Colleges and Universities.** Higher Education Panel Report, No. 15, August, 1973.

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Atelsek, Frank J. and Gomberg, Irene L. **Bachelor's Degrees Awarded to Minority Students, 1973-74.** Higher Education Panel Report, No. 24, January, 1977.

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Gomberg, Irene L. and Atelsek, Frank J. **Major Field Enrollment of Junior-Year Students, 1973 and 1974.** Higher Education Panel Report, No. 26, April, 1976.

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Gomberg, Irene L. and Atelsek, Frank J. **Composition of College and University Governing Boards.** Higher Education Panel Report, No. 35, August, 1977.

Atelsek, Frank J. and Gomberg, Irene L. **Estimated Number of Student Aid Recipients, 1976-77.** Higher Education Panel Report, No. 36, September, 1977.

Single copies of the above reports may be obtained from the Higher Education Panel, American Council on Education, One Dupont Circle, Washington, D. C. 20036.